Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Expanding the Economic and Innovation	)	GN Docket No. 12-268
Opportunities of Spectrum Through Incentive	)	
Auctions	)	

COMMENTS OF RESEARCH IN MOTION CORPORATION

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EXECUTIVE SUMMARY

More spectrum is needed to further enable innovation, fuel growth of new networks, and continue to foster mobile broadband as a significant driver for economic growth. Research In Motion Corporation ("RIM")[1] thanks the Commission for this opportunity to play a constructive role in the proceedings and applauds the Commission for its thorough consideration of all aspects of the 600 MHz band plan in order to make the incentive auctions a success in meeting the growing demand for mobile broadband services.

The most successful mobile bands – those serving as the foundation for explosive global adoption of mobile communications services – are those that have a uniform spectrum channel plan and technical standards in all areas across all bands. This is the basis for common, interoperable devices as well as low cost, high volume devices for a global market. Thus, to ensure the long term success of the 600 MHz band, it must have a simple and consistent channel plan and include features of spectrum harmonization with similar mobile band assignments globally. Without such harmonization, there is the harsh potential that the United States network could be left behind in global markets that have harmonized. Incompatibility with global spectrum assignments would lead to the U.S. market being isolated from the global market and unable to reap the benefits of manufacturing at the scale of the global market. An objective for the U.S. band plan should include its harmonization with and suitability for adoption in other regions.

In this response, RIM has focused on providing an initial technical view of the band plan proposals in the Commission's Public Notice of May 17th, 2013.[2] Our initial review of the Down from 51 Reversed and the Down from 51 TDD plans shows them to be a less efficient approach to spectrum usage than the conventional Down from 51 plan proposed by the Commission in the Notice of Proposed Rulemaking of September 2012.[3] Moreover, the plans proposed in the Notice would be impractical to implement in mobile devices in the face of both economical and technical limitations.

RIM proposes a 600 MHz band plan that attempts to balance the objectives of the Commission in these proceedings with the technical requirements of user devices. We have endeavored to minimize uncertainty, limit the amount of guard bands, provide for flexibility, and increase the potential for global harmonization. At the same time, we have taken into account – to a reasonable degree – the challenges of handset design. These include antenna and filter performance as well as packaging constraints. We believe this provides a basis for a sound band plan design.

RIM is happy to serve as a resource as the Commission moves forward with this important effort and thanks the Commission for this opportunity.

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[1] While RIM announced a name change to BlackBerry in January, the company will continue to use RIM until the change is approved by shareholders at our Annual General Meeting in July. (*See*, RIM Press Release, *Research In Motion Changes Its Name to BlackBerry* (rel. Jan. 30, 2013), http://press.blackberry.com/press/2013/research-in-motion-changes-its-name-to-blackberry.html.

[2] *Wireless Telecommunications Bureau Seeks to Supplement the Record on the 600 MHz Band Plan*, Public Notice, DA 13-1157 (May 17, 2013) (*hereinafter* "Public Notice").

[3] *Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions*, Notice of Proposed Rulemaking, 27 FCC Rcd 12357 (2012) (*hereinafter* "Incentive Auctions NPRM").

I. INTRODUCTION

Research In Motion Corporation ("RIM") respectfully submits these comments in response to the Commission's Public Notice of May 17th, 2013 ("Notice")[4] seeking additional comment on alternative band configurations for the Commission's incentive auction to repurpose television broadcast spectrum for mobile broadband offerings as required by the Middle Class Tax Relief and Job Creation Act of 2012 ("Spectrum Act").[5]

As a global leader in wireless innovation, RIM remains a strong advocate of making additional spectrum available for mobile broadband, which we believe is critical to meeting the communications needs, demands, and expectations of a growing mobile society. Through the incentive auctions, which will harness market forces to repurpose valuable spectrum, the Commission has an unprecedented opportunity to ensure the growth of the mobile broadband ecosystem and foster innovative mobile broadband services. RIM appreciates that the Commission has considered the band plan a critical component to the success of the 600 MHz market and has requested further consideration of certain aspects of the band plan. RIM submits these comments to assist the FCC in defining a band plan that will maximize the deployment of advanced broadband services in the 600 MHz band – consistent with the Spectrum Act.[6]

RIM believes the band plan will have a significant impact on access, cost, performance, and interoperability. To obtain the most value from the 600 MHz band, the Commission must balance the challenges posed by the policy objective of interoperability and its impact on maximizing spectrum availability. If the goal of maximizing spectrum by providing different amounts of spectrum in different markets dominates, then for all practical purposes these two policy objectives will remain mutually exclusive. Mobile devices now include the 700, 800, and 900 MHz bands as well as a number of bands above 1 GHz. This requirement, combined with the constraints of technology and costs, make it

[4] Public Notice (May 17, 2013); Incentive Auctions NPRM (2012).
[5] *See*, Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, §§ 6402-03, 6407, 126 Stat. 156, 224-30, 231-2 (2012) (*hereinafter* Spectrum Act).
[6] *See*, Spectrum Act (2012).

extremely difficult to incorporate the additional multiple RF components and filters for multiple configurations within a 600 MHz band plan.

RIM agrees that both interoperability and maximizing access to spectrum are important policy goals. However, demanding both without taking into account the limitations of technology to accomplish them would result in a less than optimal frequency plan for users of both mobile broadband and television services. Further analysis needs to be done to understand how to truly maximize the use of the spectrum rather than just the amount of spectrum.[7] The underlying policy must ensure that the technical practicality of implementation in mobile devices is fundamental to every aspect of the band plan.

RIM supports the Commission's Down from 51 approach discussed in the NPRM that would put the 600 MHz uplink channels immediately below and adjacent to the uplink channels of the lower 700 MHz band. While RIM has concerns about the number of sub-bands in that plan, we are still of the view that it is the basis for a preferred approach. Indeed, the Commission itself has acknowledged the strong consensus that has developed around this approach.[8]

The following is RIM's response – focused on providing a band plan and a technical view of the band proposals – in answer to the Commission's recent Notice.

[7] A comprehensive policy discussion could include discussions on (1) the primary use and purpose of the 600 MHz spectrum in the long term, (2) the question of whether maximizing spectrum in markets that may not need the benefit of these frequencies would cause additional hardship to markets that will have the most to gain from access to the 600 MHz band, and (3) whether the advantages of multiple bands would outweigh the benefits of a single harmonized band.

[8] *See, e.g.,* Letter from AT&T Inc., National Association of Broadcasters, T-Mobile, Intel Corporation, Qualcomm, and Verizon Wireless to Gary Epstein and Ruth Milkman, FCC (Jan. 24, 2013); Comments of T-Mobile USA, Inc. at 10-13; Reply Comments of Ericsson at 13-29. *See also, NPRM,* 27 FCC Rcd at 12421, para. 178. Depending on the quantity of spectrum that is repurposed, the downlink band could be situated on both sides of channel 37 (assuming existing channel 37 operations remain on that channel).

II. THE PROPOSED DOWN FROM 51 REVERSED BAND APPROACH CREATES CHALLENGES THAT WOULD IMPEDE THE EFFECTIVE AND EFFICIENT USE OF THE 600 MHZ BAND AS WELL AS SEVERELY IMPACT DEVICE DESIGN.

A. THE DOWN FROM 51 REVERSED BAND PLAN IS LESS EFFICIENT THAN THE COMMISSION'S DOWN FROM 51 APPROACH DUE TO ADDITIONAL GUARD BAND REQUIREMENTS.

The proposed Down from 51 Reversed Band Plan ("reversed plan") to put the 600 MHz downlink channels immediately below the 700 MHz uplink channels and have the 600 MHz uplink channels adjacent to television or channel 37 services would lead to an inefficient use of valuable spectrum. The reversed plan does not follow one of the important tenets of band planning, which is to place like aspects of services in adjacent channels (i.e. uplinks beside uplinks, downlinks beside downlinks). Consequently, as the Commission has indicated in its Notice, there must be additional spectrum allocated for guard bands. The reversed plan requires significant guard bands and filters in mobile devices to protect television and Wireless Medical Telemetry Service (WMTS) services. The perceived advantages of this configuration[9] in providing a consistent mobile downlink band across plan variations do not outweigh the amount of spectrum lost for guard bands.

For the reversed plan, RIM's initial estimate for the size of the guard band between the 700 MHz uplink channels and the 600 MHz downlink channels is at least 10 MHz. This is based on other similar band implementations (e.g. 3GPP band 12, band 28, and band 20). This guard band is needed to provide protection for both base station-to-base station interference as well as device-to-device interference.

The reversed plan also places mobile transmitters adjacent to television receiver channels. This would include adjacent channel scenarios as well as, in some cases when at the cell edges, co-channel operation of television receivers and mobile device uplinks. This creates the potential for the user's mobile devices to interfere with television reception as the device and the television receiver may be in close proximity to each other, particularly in high density residences. This potential for interference would require an additional guard band and filters in the mobile device for each variation of the band

[9] *See*, Public Notice (May 17, 2013).

plan. Although we have not determined the minimum size of this guard band in detail, we expect it would be in the order of 5 MHz based on practical experience from the adjacent 700 MHz band.

Additional guard bands will also be required if the mobile usage extends to channel 37 or below in order to protect channel 37 services (i.e. Radio Astronomy Service (RAS) and WMTS). As mobile devices may be operating in locations where WMTS is being used (i.e. within hospitals), it will be necessary to provide guard bands adjacent to channel 37 to allow for the necessary filter roll-off in the mobile device transmitters in order to sufficiently attenuate their adjacent channel emissions to protect WMTS.[10] Although we have not determined the minimum size of this guard band in detail, we expect it would be in the order of 5 MHz based on practical experience from the adjacent 700 MHz band.

Altogether, the reversed plan would require a guard band at 698 MHz, a duplex gap, and guard bands adjacent to channel 37 or television channels for a total of 25 to 35 MHz of spectrum that would be need to be cleared from television service, but would be unusable by mobile services.[11] Of the 84 MHz of spectrum that could be repurposed above channel 37, 25 MHz (i.e. about 30%) would have to be used for duplex gaps and guard bands and this number could increase up to 35 MHz if spectrum below channel 37 were also to be cleared. This does not seem "technically reasonable" as required by the Spectrum Act[12] when compared to other band plan options.

B. THE REVERSED PLAN IS NOT PRACTICAL TO IMPLEMENT IN MOBILE DEVICES.

The Commission's proposed reversed plan would be difficult, and likely impractical, to implement in mobile devices. In this plan, depending on the amount of spectrum that is cleared, the duplex gap shifts its location. In the context of a mobile device transceiver, this effectively means two RF chains, each

[10] *See, e.g.,* Comments of Philips Healthcare, GN Docket No. 12-268, at 4-6. *See also,* 47 CFR § 15.709(c)(4). Note that it would be necessary to stipulate that compliance by mobile devices to the field strength limits set by 47 CFR § 15.709(c)(4) would be sufficient for device manufacturers to disclaim liability for any interference to WMTS.

[11] This is the sum of 10 MHz for guard space with the 700 MHz band and 10 MHz for a duplex gap plus 5 MHz for guard space to protect channel 37.

[12] As discussed in the NPRM, the Spectrum Act requires that the "guard bands . . . be no larger than is technically reasonable to prevent harmful interference between licensed services outside the guard bands." NPRM, 27 FCC Rcd at 12412, para. 152 *citing* Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, § 6407(b), 125 Stat. 156 (2012).

with multiple filters to support the multiple band plan options illustrated in the Notice. While this approach might be technically possible, it is impractical from both an economical and a design point of view due to the number of filter components required. Each of the multiple filter combinations consumes valuable space within the device that could be utilized to support other options or improved battery lifetime. There would be an extra layer of design challenges due to the dual RF chains and additional RF performance losses due to the switches needed to select each option. This complexity is in addition to the filters that would be required to protect channel 37 and television services, even with the guard bands mentioned above.

Taking all of these requirements into account, we believe that the reverse plan would be extremely difficult to implement in a user handset (especially in combination with the requirements to support many other bands in addition to the 600 MHz band).

III. USE OF THE DUPLEX GAP BY OTHER DOWNLINK SERVICES REQUIRES THE USE OF COMPATIBLE SIGNAL STRENGTHS.

In the Notice, the Commission discussed a conventional Down from 51 plan in which some downlink services are placed in channels within the duplex gap. These services could utilize technology including Advanced Television Systems Committee (ATSC) television broadcast, future mobile television broadcast, LTE Multimedia Broadcast Multicast Service (MBMS), and LTE Supplemental Downlinks (SDL). Allowing such services in the duplex gap could be technically viable contingent upon several factors: (1) it must be a downlink service, (2) the service must not be required to operate within a single mobile device at the same time as adjacent 600 MHz LTE mobile services, and most importantly (3) the signal strengths must be consistent with the typical signal strengths in the coverage area of the local mobile system (i.e. in the range of -97 dBm to -25 dBm[13]).

[13] This is the general range of signal strengths specified for mobile device receivers discussed in the 3GPP Specifications. *See e.g.*, Section 7, *User Equipment (UE) Radio Transmission and Reception*, ETSI TS 136 101 V11.4.0 (2013-4).

Suitable technical constraints to assure compatible signal strengths in coverage areas, in addition to the service constraints discussed, would allow downlink services to be licensed for the duplex gap. The incompatibility that would exist with the operation of high power stations in the duplex gap was highlighted in comments to the Commission's Notice of Proposed Rulemaking on Incentive Auctions ("NPRM").[14] The careful repacking of broadcast or other downlink channels to avoid high power transmitters in adjacent channels or locations nearby the mobile system coverage areas would relieve the technical concerns. In some cases this compatibility of signal strength, for example, may be achieved by locating the television transmitter some distance outside the mobile service coverage area. In other scenarios the television transmitters and antennas may be collocated with the cell sites of the mobile service in a Single Frequency Network (SFN) configuration. This collocation will help to ensure that compatible signal strengths are maintained in the mobile coverage area.

IV. THE TDD BAND PLAN POSES SIMILAR CHALLENGES TO THE DOWN FROM 51 REVERSED BAND PLAN.

The Down from 51 TDD Band Plan ("TDD plan") faces similar challenges to the reversed band plan and will lead to an inefficient use of spectrum and be difficult to implement in mobile devices. As in the reversed plan, an estimate of 10 MHz will be required for a guard band between the 700 MHz uplink and the 600 MHz band. The TDD plan would also require a guard band to protect television receivers and channel 37 services (RAS and WMTS) from nearby mobile transmissions in adjacent channels. Thus, the TDD plan would require 15 to 25 MHz of cleared spectrum to be dedicated to the necessary spectrum duplex gap and guard space.

While there is an apparent advantage to TDD because it does not use a duplex gap in the frequency space, the reality is that TDD systems require an equivalent transmission and reception isolation that is implemented in the time domain. In a typical TDD system, transmit and receive intervals must be

[14] *See, e.g.*, Letter from Trey Hanbury, Hogan Lovells, to Marlene Dortch, Secretary, FCC (Feb. 1, 2013), GN Docket No. 12-268, at Att. p. 14-7 (market variation with high power services between the uplink and downlink bands); Comments of Alcatel-Lucent, GN Docket No. 12-268, at 14-6; Comments of CTIA – The Wireless Association, GN Docket No. 12-268, at 25, 28.

isolated by an amount of time equivalent to the transit time of radio signals for the largest cell size used by the system. This is the functional equivalent of the duplex gap in the FDD frequency space and represents a similarly unusable portion of the spectrum resource.

In the TDD plan, 5% to 10% of spectrum capacity would be used for the time domain duplex. The LTE TDD frame interval is 10 ms, during which there may be one or two switch timeslots (each of 500 microseconds) meaning about 5% or 10% of the TDD time is allocated to channel turnaround. Therefore, the TDD plan operationally includes a frequency efficiency loss of 4.2 MHz (i.e. 5% of 84 MHz) in addition to the 15 MHz required for guard spaces as discussed above. Consequently, the total unused spectrum under the TDD plan would be 19.2 MHz. If the cleared spectrum were to extend below channel 37 then the total equivalent unused spectrum could be as high as 29.2 MHz due to additional guard bands on either side of channel 37.

Most mobile devices include a common "quad" (now "penta") band configuration that provides global coverage and interoperability for GSM systems and their derivatives in five global bands. This configuration results from a globally harmonized set of bands that share common technical standards and filters. Today, these five bands set the base price point for economies of scale in components and manufacturing and are the basis for the wide service coverage and low cost devices consumers have become accustomed to expect. The 600 MHz TDD plan illustrated in the Notice[15] shows 5 filter ranges to accommodate the potential extent of the variations in channel clearing. Requiring five sub-band implementations in the mobile device to cover just the 600 MHz band in the U.S., when five bands provide global coverage for consumers, is excessive. A similar difficulty in requiring a multiplicity of filters to cover the clearing variations is also evident in the reversed plan[16] where ten filter combinations are illustrated. Limitations in space and RF performance make this an impractical option.

The TDD plan would also be difficult implement in mobile devices. The Commission's Notice illustrates multiple market variations for the TDD plan in which the total filter configuration required to

[15] Fig. *Market Variation in Down from 51 TDD, more than 84 MHz cleared*, Public Notice (May 17, 2013) at p. 6.
[16] Fig. *Market Variation in Down from 51 Reversed, more than 84 MHz cleared*, Public Notice (May 17, 2013) at p. 4.

ensure operability in all band situations contains five filters. This is the equivalent of adding five RF front ends to the radio design of a mobile device transceiver. Limitations in space and RF performance make this an impractical option.

V. RIM PROPOSES A PRACTICAL DOWN FROM 51 PLAN THAT ALLOWS FOR TECHNICAL CERTAINTY.

RIM proposes a 600 MHz band plan that aims to balance the Commission's objectives with the technical requirements of user devices. With this plan, we have endeavored to minimize uncertainty, limit guard bands, provide for flexibility, and increase the potential for global harmonization.

There is no simple tradeoff among the goals of (1) flexibility in accommodating the amount of spectrum cleared, (2) the proportionally wide frequency range covered, (3) interoperability, and (4) the user device technical design criteria. In fact, RIM believes that in order to develop an ideal plan, there must be credible and practical expectations for each of these goals. In our comments below, we propose a 600 MHz band plan that attempts to reliably satisfy the goals of the Commission. We believe this plan has a good probability of being accepted (harmonized) outside of the United Sates. Although this plan poses a number of technical challenges in user device implementation, we expect that these challenges can be overcome in the near future and that this approach presents a more feasible approach to implementation in mobile devices than other proposed band plans.

Design Principles

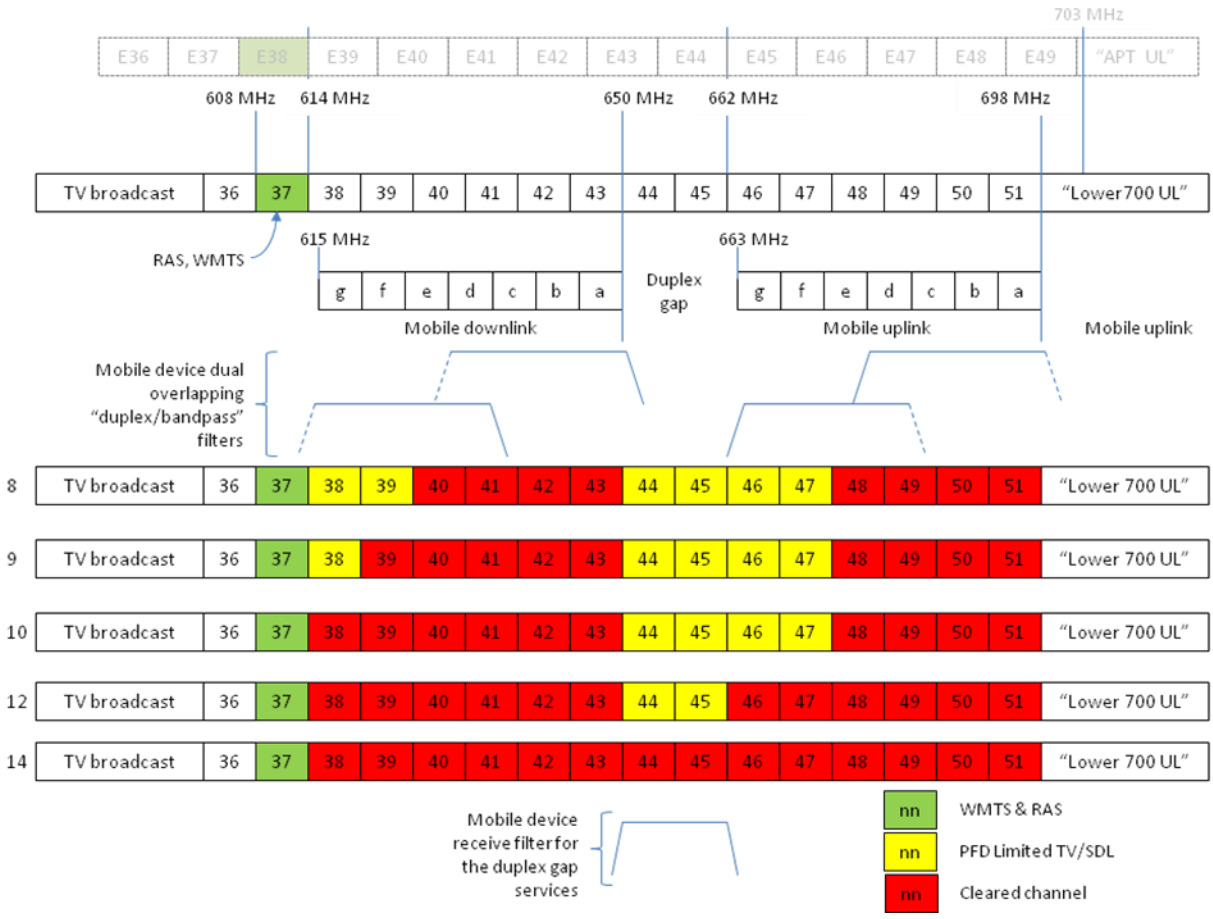
- Minimize uncertainty – this plan assumes that a minimum of eight television channels and a maximum of twelve television channels will be cleared, excluding the duplex gap. This is necessary to avoid multiple handset designs.
- Note antenna and filter constraints – limiting the span of the repurposed bandwidth to 84 MHz will help facilitate antenna design for devices and bandpass filters. However, there will be a significant impact on the antenna performance for personal mobile devices even for this bandwidth at 600 MHz.

- Permit SDLs – Supplemental DownLinks (SDLs) may be placed below channel 37 in areas where additional channels are cleared. Similarly, in areas where fewer channels can be cleared, SDLs may be placed in the cleared television channels.
- Minimize the use of guard bands – in this plan, similar services are placed adjacent to each other. The 600 MHz mobile uplinks are adjacent to the 700 MHz uplinks and the mobile downlinks are adjacent to the television broadcast stations (thus avoiding guard spaces with the 700 MHZ band and the television channels).
- Maintain a fixed duplex gap location – having more than one defined gap would be impractical to implement in user devices.
- Provide for flexibility – the design may be based on dual overlapping filters to provide a small duplex gap and a wide passband. The dual overlapping filters would also accommodate some variation in the availability of cleared channels in the band plan.
- Manage signal field strength density limits – (a) mobile base station downlink transmitters that are operating adjacent to channel 37 must be sited such that the field strength levels necessary to protect the RAS and WMTS are ensured and (b) the repacking of the television stations must ensure that the television broadcast signals that are adjacent to the mobile downlinks have similar signal field strengths to the mobile signals in the coverage areas.
- Increase potential for global harmonization – Although it is not possible to predict what other jurisdictions may do with the 600 MHz band, we believe that by limiting the range to above channel 37 and also taking into account the alternative 8 MHz channel plans (such as that used in Europe), we will increase the potential for future harmonization.

While the proposed plan could undoubtedly be modified to account for some additional special conditions of the 600 MHz incentive auction band, this would likely add complexity and cost, limit compatibility with the other bands, and possibly necessitate multiple handset designs. Changes to this

proposed plan would thus quickly dissolve certainty into an impractical and uncertain plan for mobile devices. RIM believes that this plan provides a basis for a sound band plan design.

Practical Down from 51 Plan with Market Variation



Notes for the plan diagram:

a) For reference, the EU channel plan is shown in the top line with 8 MHz channel designations E36-E49.

b) The third line shows mobile downlink of seven 5 MHz channels [615-650 MHz] and uplink of seven 5 MHz channels [663-698 MHz]. These are separated by a duplex gap of 13 MHz [650-663 MHz] corresponding to television channels 44 and 45 [and EU channel E44]. The duplex

gap is arranged to match television channel locations in both the US and EU television plans and so to permit some field strength constrained television broadcast services or SDL in the duplex gap.

c) The dual overlapping duplex and passband filters in mobile devices are shown in the fourth line. These are illustrated with 20 MHz passband. The lower pair covers mobile channels d, c, b and a, the upper pair covers channels g, f, e and d. This dual overlapping filter combination is the functional equivalent to the dual overlapping filters being developed for the 3GPP 700 MHz band plan 28.

d) Options are shown for variations in the number of cleared channels.

e) At the bottom is indicated the passband filter that would be needed within the mobile devices to receive services located in the duplex gap. This could be for broadcast television services or LTE MBMS, or LTE SDL channels. This extra filter, for example, is the functional equivalent to what might be used for reception of the lower D and E downlink-only channels in the 700 MHz band plan.

RIM proposes that this skeleton plan become the basis for further industry and FCC discussions for the establishment of the details and the necessary rules for channel assignments, PFD, and adjacent-channel protection.

VI. CONCLUSION

The reverse FDD and TDD plans would neutralize significant amounts of spectrum and be extremely difficult to implement in personal mobile devices. These proposals are unlikely to meet the Commission's objectives and are less efficient than the conventional plan to place the uplink adjacent to the 700 MHz band.

RIM believes that a successful band plan would (1) be practical to implement in mobile devices, even taking into account other band requirements, (2) minimize spectrum used for guard bands, (3) not require

multiple filter variations, (4) confine the total operational bandwidth to the 84 MHz above channel 37, and finally, (5) include deployment rules to assure compatibility of signal strength for the television and mobile channels.

The incentive auctions are a groundbreaking process for making more spectrum available for wireless mobile broadband. The Commission's laudable efforts to draw on both public and private expertise by engaging all stakeholders and issuing this Notice to further consider certain aspects of the plan will facilitate access to and innovative uses of the new 600 MHz band.

Respectfully submitted,

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